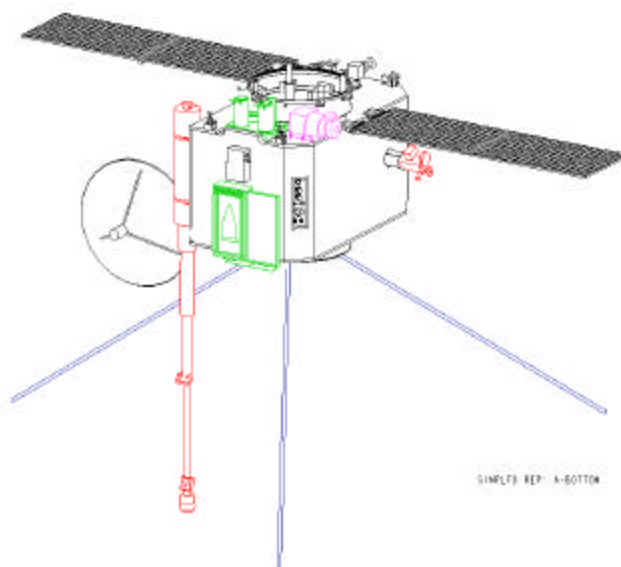
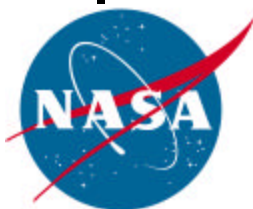


# SOLAR-TERRESTRIAL RELATIONS OBSERVATORY (STEREO) PROJECT PLAN



December, 2001



**GODDARD SPACE FLIGHT CENTER**  
**GREENBELT, MARYLAND**

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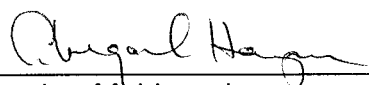
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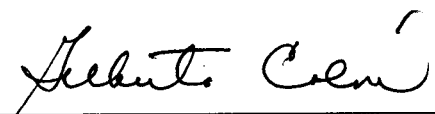
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## STEREO PROJECT PLAN

Approved by:

FOR   
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**CHANGE HISTORY LOG**

<b>Revision</b>	<b>Effective Date</b>	<b>Description of Changes</b>
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## 1. **INTRODUCTION**

STP Projects are defined by the coordination between the OSS and the SEC community and are documented in the SEC Roadmap, a document that is subordinate to the Space Science Enterprise Strategic Plan. STEREO's mission is to advance the understanding of the three-dimensional structure of the Sun's corona, especially regarding the origin of coronal mass ejections (CMEs), their evolution in the interplanetary medium, and the dynamic coupling between CMEs and the Earth environment. CMEs are the most energetic eruptions on the Sun, are the primary cause of major geomagnetic storms, and are believed to be responsible for the largest solar energetic particle events. CMEs may also be a critical element in the operation of the solar dynamo because they appear to remove dynamo-generated magnetic flux from the Sun.

The STEREO Mission will be accomplished through the use of two spacecraft orbiting the Sun at a radius of one astronomical unit, one drifting ahead of the Earth and one behind. Simultaneous extreme ultra-violet (EUV) and visible image pairs along with simultaneous measurements of fields and particles will be obtained by STEREO at gradually increasing angular separations in the course of the mission. The STEREO spacecraft are outfitted with two instrument suites and two instruments: the In-situ Measurements of Particles and CME Transients (IMPACT) managed by University of California, Berkeley (UCB); the Sun-Earth Connection Coronal and Heliospheric Investigation (SECCHI) managed by Naval Research Laboratory (NRL); the Plasma and Suprathermal Ion Composition (PLASTIC) managed by the University of New Hampshire (UNH); and STEREO/WAVES (SWAVES) managed by Observatoire de Paris-Meudon with Goddard Space Flight Center as lead U.S. Co-Investigator and the University of Minnesota (UMN) as the U.S. Project Manager. The two STEREO spacecraft are being managed, designed and fabricated by the Johns Hopkins Applied Physics Laboratory (JHU/APL). Communications between the ground and spacecraft will be accomplished through the use of the NASA Deep Space Network (DSN). The STEREO Science Center (SSC) capture, extract and archive STEREO science data.

Concept studies for STEREO were initiated upon approval of the program roadmap. Mission Integration and spacecraft development were directed to the Johns Hopkins University, Applied Physics Laboratory (JHU/APL). The four investigations were selected via the release of Announcement of Opportunity (AO) 99-OSS-01 by Code S of NASA Headquarters. STEREO Mission Systems Requirements Review (460-RVW-0001 and 0003), held on June 7-9, 1999 established the overall approach for implementing the mission. Independent Assessment and Pre-Confirmation Review (460-RVW-0052), held in January of 2001 evaluated progress of the formulation process. The mission is scheduled to launch no later than December, 2005.

## 2. **OBJECTIVES**

Baseline Science Objectives:

The principal science objectives corresponding measurement requirements to be addressed by the STEREO mission are presented in Table 1.

**Table 1. Principal Science Objectives**

<b>Science Objective</b>	<b>Measurement Required</b>
Understand the causes and mechanisms of CME initiation	Determine the CME initiation time to an accuracy of order 10 minutes
	Determine the location of CME initiation to within +/- 1 degree of solar latitude and longitude
Characterize the propagation of CMEs through the heliosphere	Determine the evolution of the CME mass distribution as it propagates from the low corona to 1 AU
	Determine the CME speed as it propagates from the low corona to 1 AU
	Determine the direction of CME propagation as the CME evolves from the low corona to 1 AU
Discover the mechanisms and sites of energetic particle acceleration in the low corona and the interplanetary medium	Characterize energetic particle distribution functions in-situ for electrons and ions of interest at particle energies typical of solar energetic particle populations
	Determine the location of particle acceleration in the low corona and through the interplanetary medium
Improved determination of the structure of the ambient solar wind	Obtain a time series of the solar wind temperature at two points separated in solar longitude
	Obtain a time series of the solar wind density at two points separated in solar longitude
	Obtain a time series of the solar wind speed at two points separated in solar longitude
	Obtain a time series of the solar wind magnetic field at two points separated in solar longitude

The scientific program does not depend on the phase of the solar cycle because CMEs and the other phenomena to be studied are common to all phases of the cycle, though more frequent around solar maximum.

Level 1 or Program Level Requirements (PLRs) are developed by Office of Space Science and will be documented as an addendum to the STP Program Plan by mission confirmation.

### 3. **CUSTOMER DEFINITION AND ADVOCACY**

The STP Program customer advocacy is achieved through interactions between the OSS and the science community. The STEREO Project Scientist (PS) provides a scientific interface between the Project Manager, the SEC community and the NASA Headquarters STP Program Scientist. The PS is the technical advisor to the Project Office and provides scientific evaluations and assessments of the project.

Contact between the Project Office and the science community is through Program Office, scientific meetings, technology showcases and periodic workshops to solicit feedback on project processes. The SEC Theme Program Integration Manager in the GSFC Associate Director's Office will support the interface with OSS and the integration of the STP Program and Projects into the SEC Theme.

### 4. **PROJECT AUTHORITY**

Project authority is delegated from the Associate Administrator for the Office of Space Science (AA/OSS) through the Goddard Space Flight Center (GSFC) Center Director to the STP Program Manager within the Flight Projects Directorate at GSFC. GSFC has been designated as the Governing Program Management Council (GPMC) for the STEREO Project. The STEREO Project will be subject to direction of the GPMC.

### 5. **MANAGEMENT**

#### 5.1 NASA Headquarters

In accordance with the NASA Strategic Management Handbook (NPG 1000.2, January 2000), NASA Headquarters Office of Space Science (OSS) has the responsibility for establishing overall STP Program policy, soliciting and selecting missions, establishing the Program and science objectives, requirements and priorities, allocating the Program budget guidelines, and assessing Program performance. OSS is responsible for formulating the elements, structure, and content of Programs and for defining the Project Level 1 Requirements. OSS develops and maintains the STP Program Commitment Agreement (PCA). NASA Headquarters also has the responsibility for establishing the formal agreements with other U.S. Government organizations and with foreign space organizations and institutions. The Space Science Enterprise AA (ESE AA) has delegated the above programmatic responsibility for the STP Program to the Flight Programs Division (Code SD) for the development and launch of space missions, the Research Program Management Division (Code SR) for scientific responsibility, and the SEC Science Director for overall SEC policy and management.

#### 5.2 Lead Center

The Space Science Enterprise AA (SSE AA) has assigned GSFC to be the Lead Center for the STP Program. The GSFC Center Director is responsible for overall Program success and is accountable to the SSE AA. The GSFC Center Director holds the STP Program Manager

accountable for directing a program, which meets Agency, Center, and STP Program requirements within established cost, schedule, and performance boundaries. The GSFC Center Director shall certify the flight readiness of each STP Project to the AA for Space Science.

If another NASA center is designated as the implementing center for a project, the center and project management shall formulate roles and responsibilities that are compliant to their internal procedures. The project plan shall document these roles and responsibilities, be compliant with the STP Program Plan, and be compliant to the respective center's internal procedures.

### 5.3 Program Office

The STP Program Manager is responsible for the total range of program activities from support to NASA Headquarters during Program Formulation through Project Implementation and on-orbit checkout. The STP Program Manager is responsible for the program cost, schedule, technical performance and the management system throughout the life of the program, as well as defining metrics for assessment of program formulation and implementation performance. The Program Office develops the integrated budgetary requirements and schedule based on OSS budgetary guidelines for the STP Program and recommends the Program content to Headquarters for approval. The STP Program Office defines the content and schedules consistent with the STP PCA and Program Operating Plan (POP) agreements. Resource requirements for each project from Formulation through Implementation are defined to include funding, manpower, facilities, technical and institutional support, launch facilities, and other resources such as tracking and data capabilities and services which make project success possible. Program risks and internal agreements are included as well.

The Program Office establishes operational policies for the STP Program, ensures appropriate independent review of STP Projects (in coordination with STP Program Executive), monitors the progress of each project, reports project and program status to GSFC and NASA management, recommends necessary corrective and preventative actions. The Program Office is responsible for ensuring that each STP Project stays within the committed cost, schedule, performance, reliability, and safety requirements. The Program Office promotes efficiencies through the application of innovative management practices, the identification and implementation of inter-project synergies, and the capture and application of lessons learned. The Program Office supports OSS in the preparation of STP Program Announcement of Opportunities (AO's), NASA Research Announcements (NRA's), and NASA interagency and international agreements associated with STP Projects. The Program Office manages the STP Technology Program and coordinates E&PO efforts for the STP Projects. For projects that are GSFC led, the GSFC Center Director shall appoint a Project Manager who is responsible for the above actions for each project. Similarly, for projects led by other NASA centers, the respective center director shall appoint the project manager.

## 5.4 Project Office

The STEREO Project Office is responsible for the management of STEREO Project development, launch, and on-orbit checkout. The Project Office develops the integrated budgetary requirements and recommendations and defines schedule based on Office of Space Science budgetary guidelines. Resource requirements for the Project from definition and development through mission operations are defined as including funding, manpower, facilities, technical and institutional support, launch facilities, and other resources such as tracking and data capabilities and services which make mission success possible. Project risks and internal agreements are indicated, as well. The Project Office establishes operational policies, assures appropriate independent review of STEREO elements, monitors the progress of each element, reports status to GSFC and NASA management, and recommends necessary corrective and preventative actions. The Project Office promotes efficiencies through the application of innovative management practices, the identification and implementation of inter-mission synergies, and the capture and application of lessons learned. The Project Office supports the Office of Space Science in the preparation of the STEREO NASA Research Announcements (NRAs) and NASA interagency and international agreements associated with STEREO. The GSFC Center Director appoints a Project Manager who is responsible for the above actions for the mission.

The project organizational structure is shown in Figure 1. Individual roles, responsibilities, and skills are defined either in the employees Position Description (PD), if they are civil servant or their task statement, if they are a contractor.

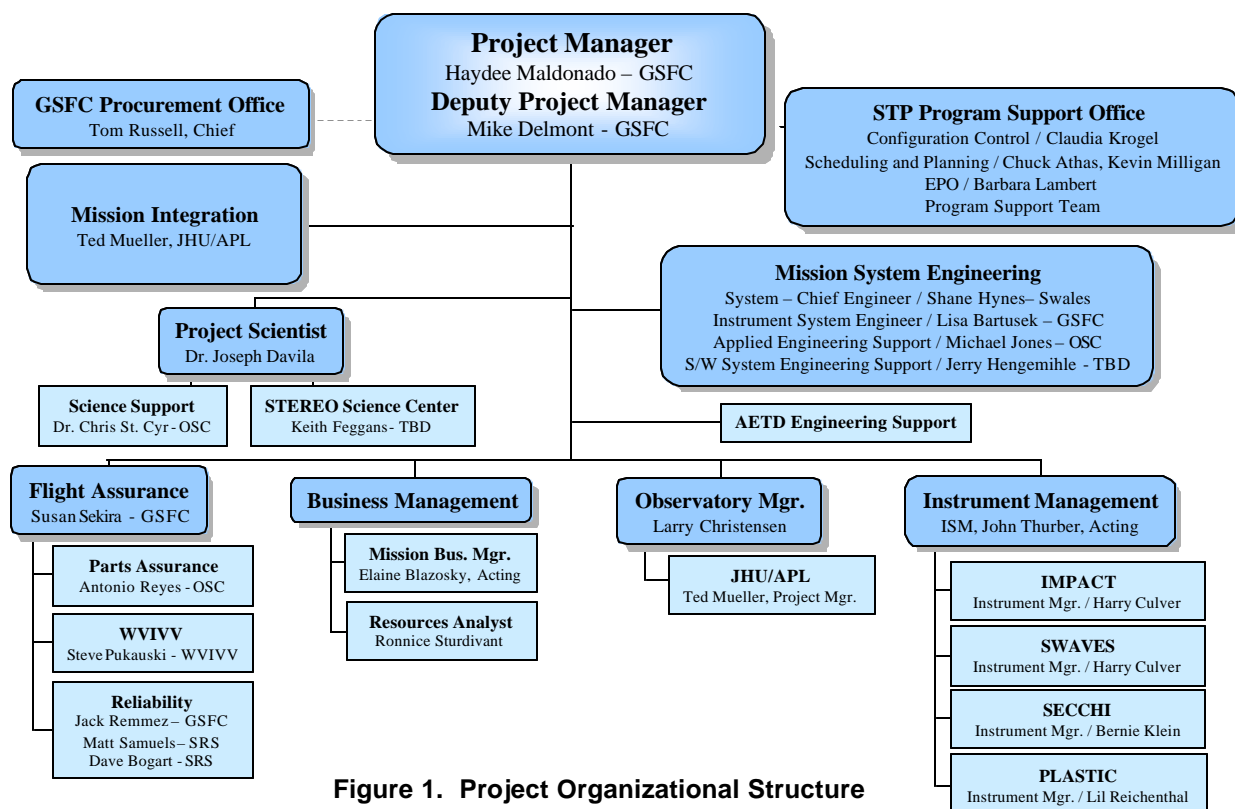


Figure 1. Project Organizational Structure

## 5.4.1 Project Management Responsibilities

### 5.4.1.1 Project Manager (PM)

The PM is responsible for ensuring the performance of all functions necessary for management of the project. He/she is responsible for project-wide planning and evaluation; personnel management; systems integration, tests, reliability, and quality assurance; system safety; configuration management; spacecraft compatibility.

### 5.4.1.2 Project Scientist (PS)

The PS is responsible for ensuring the satisfactory accomplishment for the scientific objectives of the mission. The PS reviews the implementation of the project to ensure that the total mission is consistent with the overall scientific objectives. The PS provides leadership in ensuring that the scientific data are effectively used, and the scientific results of the mission are expeditiously produced. He/she evaluates all scientific requirements and provides guidance to the project manager and others involved in the program.

### 5.4.1.3 Deputy Project Manager (DPM)

The DPM supports the PM in directing all phases of the project and has project-wide responsibility for personnel management, planning, and evaluating all activities on a day-to-day basis. The DPM provides technical management to the team in order to enable them to meet cost, schedule, and performance commitments. In the absence of the PM, the DPM assumes full responsibility for the project.

### 5.4.1.4 Systems Assurance Manager (SAM)

The SAM is responsible to the PM for all flight assurance disciplines of the project to ensure that the spacecraft, instruments, and ground system equipment will meet their intended performance objectives. These disciplines include quality assurance, design review, reliability, system safety parts, materials, processes, contamination control, and verification testing. The SAM receives line supervision from the Office of Flight Assurance and maintains independence via regular reporting pathways via that office.

### 5.4.1.5 Observatory Manager (OM)

The OM is responsible for the efforts of the government and industry team to identify the mission-imposed observatory requirements, to develop subsystems and systems to meet those requirements and to demonstrate that the observatory and its components meet their functional performance goals in the launch and space environments. The OM is responsible for planning and managing JHU/APL's tasks so that they will be completed on schedule and within the available resources.

#### 5.4.1.6 Instrument Systems Manager (ISM)

The ISM is responsible to the PM for close liaison and monitoring of the instrument development being performed by the PI teams and for evaluation of instrument performance after launch. The ISM must ensure, through management and technical review of designs, that the instruments meet the technical performance, cost, and schedule parameters for the basic mission requirements. The instrument Systems Manager is responsible for managing the spacecraft/instrument interfaces and for ensuring that the related ground support equipment is provided. The ISM supervises the work of a team of instrument managers and manages the efforts of engineering specialists from other organizational elements and/or support contractors.

#### 5.4.1.7 Instrument Manager (IM)

The IM is responsible to the ISM for technical management and monitoring of each instrument development being performed by the PI team. The IM must ensure, through technical review of designs, that each instrument meets the technical performance, cost and schedule parameters for the basic mission requirements. The IM is responsible for initiating, planning, organizing, directing, and implementing all work on each instrument.

#### 5.4.1.8 Deputy Project Manager Resources (DPMR)

The DPMR is responsible to the PM and is an integral member of the management team. The DPMR contributes business management expertise to the establishment of technical program objectives and is responsible for the application of business, financial management, and performance measurement techniques to the accomplishment of those objectives.

### 5.4.2 Teaming Arrangements

The primary teaming arrangements for implementation and operations are between NASA GSFC, The Johns Hopkins University Applied Physics Laboratory (JHU/APL), Naval Research Laboratory (NRL), Centre National de La Recherche Scientifique Observatoire de Paris, France, University of California, Berkeley, and University of New Hampshire.

#### 5.4.2.1 GSFC

The GSFC provides project management, instrument management, science support, the STEREO Science Center and public education and outreach. GSFC is also responsible for overall implementation of the STEREO Mission.

#### 5.4.2.2 Mission Integrator

The Mission Integrator, the JHU/APL, under contract to GSFC, is responsible for providing system engineering; spacecraft development; mission integration; mission design and navigation; spacecraft and associated ground support equipment (GSE); observatory

integration and test (I&T) and associated GSE; mission operations; and education and outreach.

#### 5.4.2.3 Instruments

Four other major institutional partners, under contract to GSFC, are responsible for the scientific success of STEREO and have the following responsibilities: (1) NRL - SECCHI; (2) Centre National de La Solar Terrestrial Relationship Recherche Scientifique, Observatoire de Paris France - SWAVES; (3) University of California, Berkeley: IMPACT; and (4) University of New Hampshire – PLASTIC.

#### 5.4.3 Special Boards and Committees

The STEREO mission recognizes two technical challenges and has formed special committees for their management: Electromagnetic Interference and Contamination Control. Each committee is chaired by an expert in the relevant field and has membership from each of the instrument teams, spacecraft, and project office. Teams will each produce a mission level implementation plan, as well as generate guidelines and training as applicable.

STEREO science priorities and issues are managed by the STEREO Science Working Group, chaired by the Project Scientist. Membership includes representatives from each of the instrument teams.

### 5.5 Reporting Requirements

<i>Forum</i>	<i>Report</i>	<i>Schedule</i>
Goddard Space Flight Center PMC	Technical Progress, Cost, Schedule	Monthly
GSFC Program Operating Plan	Technical Progress, Cost, Schedule	Twice a Year
OSS Weekly Status Reports	Electronic Weekly Progress Report	Weekly, after CDR

## 6. TECHNICAL SUMMARY

The STEREO Mission Systems Requirements Document (460-RQMT-0001) establishes the technical requirements of the mission and the technical resource allocations assigned to implement those requirements. System Interface Control Documents (ICD's) are used to define and control all interfaces. The Mission Design Review/Confirmation Assessment data package captures the baseline mission, design, and operations concepts.

## 6.1 Mission

The STEREO mission consists of two identically instrumented Sun-pointed observatories placed in heliocentric orbit. Both spacecraft will start their journey drifting away from Earth, one leading the Earth and one lagging. After 2 years, the spacecraft will be 44 degrees from the Sun to Earth line, and in an optimum location to observe 3-D images of the CMEs directed towards Earth.

### 6.1.1 Mission Duration

The mission requires an uninterrupted view of the Sun for an extended period of time to observe significant solar phenomena (CMEs in particular). The Science Definition Team defined a two-year mission life with one additional year of post mission data analysis. The period of two years of observation begins after both observatories have reached heliocentric orbit plus the post launch checkout period. The checkout period shall not exceed 30 days.

### 6.1.2 Orbit Definition

The STEREO space segment consists of two identically instrumented Sun-pointed observatories placed in heliocentric orbit. The orbit shall be designed such that both observatories slowly drift away from the Earth. One observatory shall drift ahead of the Earth at the rate of  $22 \pm 2$  degrees/year while the other shall drift away from the Earth in the lagging direction by  $22 \pm 2$  degrees/year.

### 6.1.3 Serviceability/Retrieval/ Disposal

On-orbit servicing, retrieval, and disposal are not required.

### 6.1.4 End to End Data Recovery

Sun and heliospheric observations shall be available<sup>1</sup> for 95 % of the observing mission duration.

### 6.1.5 Launch Requirements

The launch vehicle and launch vehicle services will be provided by the Kennedy Space Center out of the Cape Canaveral Air Force launch facility. Launch shall be no later than December 2005.

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<sup>1</sup> Using availability in the systems engineering meaning of the word. Defined in "NASA Systems Engineering Handbook" SP-6105 for example.

### 6.1.6 Daily Data Volume

Each spacecraft and the ground segment shall be designed to support a daily data volume of 5 Gigabits per observatory. Higher data rates and volumes during commissioning phase and early in the nominal mission are desirable.

### 6.1.7 Communications and Data Downlink

Data downlink rates shall be based upon a maximum of a 4-hour per day per observatory Deep Space Network (DSN) contact schedule. The communication system shall utilize frequency assignments in the X-Band spectrum. Protocols will be in accordance with the Consultative Committee on Space Data Systems (CCSDS) recommendations.

### 6.1.8 Space Weather Mode

In support of the Living with a Star Program, the spacecraft will provide a continuous low rate data stream for the purposes of space weather information and possible prediction of geomagnetic storms.

### 6.1.9 Success Criteria

The mission comprehensive success criteria are defined in the Level 1 Requirements Document, approved by the Associate Administrator for the Office of Space Science and appended to the STP Program Plan at mission confirmation.

## 6.2 Science Payload

Each observatory payload consists of four instruments suites which are detailed in the following subsections.

### 6.2.1 SECCHI

Sun Earth Connection Coronal & Heliospheric Investigation (SECCHI) is a suite of 4 instruments and a guide telescope.

#### 6.2.1.1 EUVI

Extreme UltraViolet Imager (EUVI): An extreme ultraviolet telescope that produces full Sun images from the chromospheric disk out into the corona to  $1.5 R_{\text{Sun}}$ .

#### 6.2.1.2 COR 1

Inner White Light Coronagraph (COR 1): An internally occulted visible light coronagraph that images the solar corona from  $1.1 R_{\text{Sun}}$  to  $4 R_{\text{Sun}}$ .

### 6.2.1.3 COR 2

Outer White Light Coronagraph (COR 2): An externally occulted visible light coronagraph that images the solar corona from  $2 R_{\text{Sun}}$  to  $15 R_{\text{Sun}}$ .

### 6.2.1.4 Guidescope

Guidescope: Technically not an instrument but is housed in the SCIP box and provides the fine pointing error signals, accurate to 0.1 arc-sec, to the spacecraft.

### 6.2.1.5 HI

Heliospheric Imager (HI): Two visible-light telescopes (HI1 and HI2) that together image the interplanetary medium from  $12 R_{\text{Sun}}$  to  $384 R_{\text{Sun}}$ .

## 6.2.2 IMPACT

In-Situ Measurements of Particles And CME Transients (IMPACT) is a suite of four instruments.

### 6.2.2.1 SWEA

Solar Wind Electron Analyzer (SWEA): Measures the distribution function of the solar wind core and halo electrons from  $<1$  to 3000 eV.

### 6.2.2.2 STE

Suprathermal Electron Instrument (STE): Covers the primary energy range of the impulsive electron events (from 2 to 20 keV).

### 6.2.2.3 MAG

Magnetometer (MAG): Detects magnetic fields inside and outside CMEs, measuring the vector magnetic field from  $0.005 \text{ nT} \pm 500$  or  $\pm 65,536 \text{ nT}$ .

### 6.2.2.4 SEP

Solar Energetic Particle Experiment (SEP): A set of four telescopes that measure electrons from 0.02-8 MeV, protons and He from 0.03-100 MeV/nuc, and  $^3\text{He}$  and heavier ions from 0.03-40 MeV/nuc. SEP consists of:

- Suprathermal Ion Telescope (SIT)
- Solar Electron Proton Telescope (SEPT)
- Low Energy Telescope (LET)
- High Energy Telescope (HET)

### 6.2.3 Plasma and Suprathermal Ion and Composition (PLASTIC)

A single instrument that measures the density, velocity, temperature and temperature anisotropy of solar wind protons and alpha particles, plus the abundance and distribution of solar wind and suprathermal ions (up to 100 keV/e).

### 6.2.4 STEREO WAVES (SWAVES)

A radio and plasma wave receiver that tracks radio emissions from shock-accelerated particles, from the outer corona ( $1-2 R_{\text{Sun}}$ ) to beyond Earth (to  $215 R_{\text{Sun}}$ ).

## 7. **SCHEDULES**

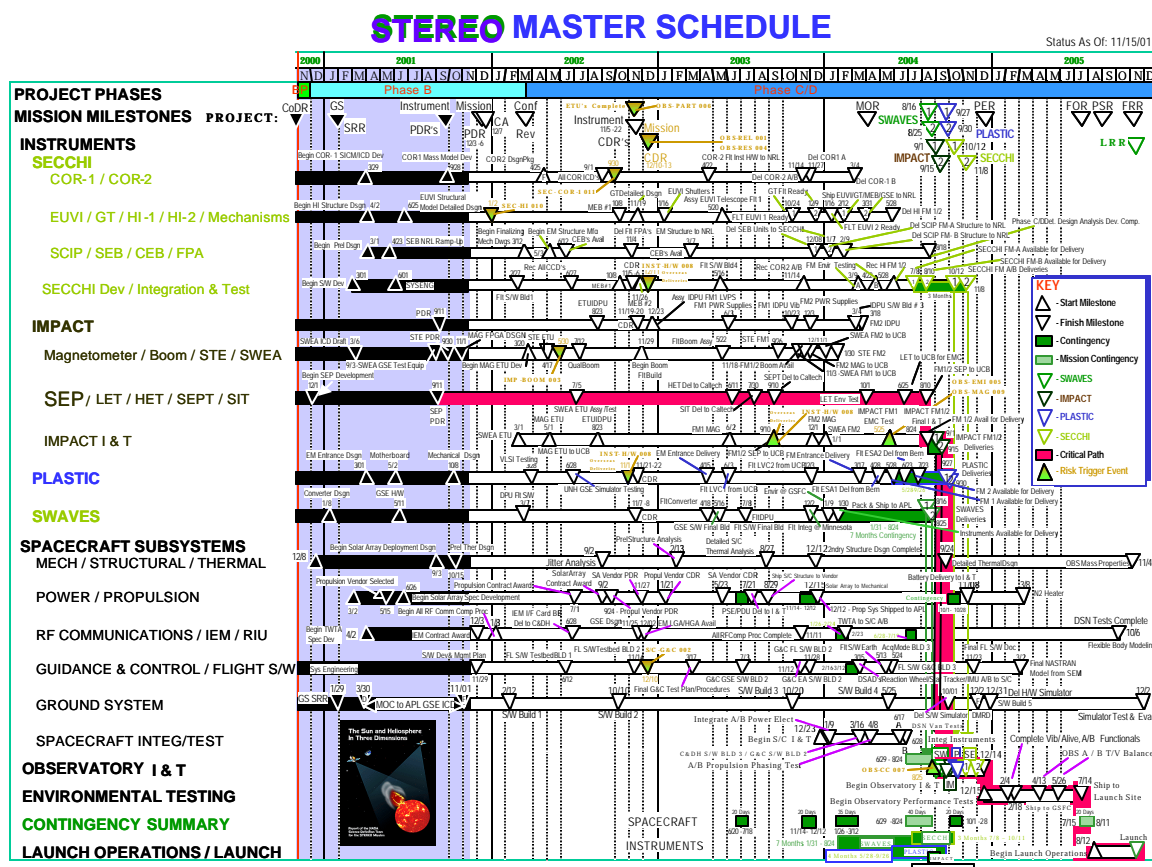
### 7.1 General

Instrument and spacecraft implementation Statements of Work require detailed, logic-based schedules. Implementation schedules include all major activities, interdependencies between major items, deliveries of end items, critical paths, schedule margins and long lead procurement needs. Major milestones and deliveries to be held under Program level configuration management are:

#### Major Project Reviews

- Confirmation Dates
- Instrument Delivery Dates
- Launch Dates

The major milestone schedule for the project is shown in Figure 2.



### Figure 2. Milestone Schedule

## 7.2 Schedule Controls

The STEREO Master Schedule will be baselined at project approval (confirmation). All changes to the Master Schedule after baseline shall be approved explicitly via document change request procedures to the STP Configuration Management Plan. All schedule changes and impacts are integrated into the resources requirements. As changes occur, the life-cycle costs of the project(s) and contingencies are updated including all programmatic impacts both internal and external to the STP Program Office.

When the proposed revised schedule violates the PCA, the revised schedule can only be adopted if a change to the PCA is subsequently approved by the AA for SSE and the Office of the NASA Administrator. The Program Manager can authorize changes to the Program Master Schedule if changes are demonstrated to be compliant with PCA milestones.

## 8. **RESOURCES**

### 8.1 Funding Requirements

STEREO shall be cost capped at \$395.5 M (in real year dollars) for total life cycle cost (LCC), including the launch vehicle and three years of data analysis. The budget for the STP program is approved annually during the POP review cycle.

### 8.2 Institutional Requirements

Institutional Requirements for STEREO are managed via the GSFC workforce planning cycle. Civil Service requirements are recorded using Statements of Work that are provided to each of the responsible organizations. Each SOW and response shows present year planning and a five-year projection. The requirements and responses from organizations are updated annually. Actual manpower usage for the current is reported monthly. Manpower planning for all projects is recorded in the Center database.

### 8.3 Controls and Descope Planning

Provided that Program Level Requirements are preserved, and that due consideration has been given to the use of budgeted contingency, the STEREO Project will pursue scope reduction and risk management as a means to control cost.

Descopes may contain planning for reductions in scientific capability. However, those shall be implemented only after consultation with and approval by the Program Scientist and configured change to the Program Level Requirements Document. The STEREO Project Plan shall include potential scope reductions and the time frame in which they could be implemented.

Table 2. contains the Descope Plan

Table 2. STEREO Descope Plan

Description	Mass (kg)	Power (W)	Cost (\$M)	Schedule	Risk	Science Impact	Implement Date
SECCHI Fine Pointing System	--	--	0.5	--	--	Degraded B, C1, D1, E1	Confirmation Review (CR)
Remove SEP	4.2	3.2	5	●	↓	F, G	Cost: CR Mass: CDR Power: Anytime
Remove STE, SWEA, and simplify boom	10	2.5	1.3	--	↓	F, G, H, I, J	Cost: CR Mass: CDR Power: Anytime
Remove SWAVES	11.4	10.2	6	--	↓	A, C3, D3, E3, F, G, H, I	Cost: CR Mass: CDR Power: Anytime
Remove COR1	7.4	2.0	4	--	--	A, B, C1, D1, E1	Cost: CR Mass: CDR Power: Anytime
Reduce Data Volume	--	TBD	--			All	CDR
Reduced/Accelerated Testing	--	--	--	●	↑	--	If needed during I&T
Limited Selective Parallel I&T	--	--	--	●	↑	--	If needed during I&T

## 9. CONTROLS

Changes to this STEREO Project Plan must be approved by all signators of this document.

The business aspects (fiscal, workforce, schedule, content and scope, related assumptions, etc.) of developing the STEREO products are controlled either by direct contract, contract task, or NASA Defense Purchase Request. Regular status reviews are conducted by the Project to monitor status of all product development efforts.

Costs, schedules and technical performance requirements (i.e., Program Level Requirements (PLR's) shall all be approved and baselined at the time of project approval to transition into implementation. The cost and schedule baselines shall encompass the entire project life, including implementation, launch, operations, and data analysis. During formulation, schedule and cost contingency levels shall be monitored and reported at each of the confirmation reviews (Phase A to B and Phase B to C). Contingency levels shall be demonstrated to be commensurate with the level of risk in the project.

After the project is approved for implementation, both schedule slack and cost contingency levels shall be monitored and reported from contractors via monthly and quarterly progress reports. A Work Breakdown Structure (WBS) will define the scope, level of detail required, and provide a common framework with schedule reporting. At the project level, cost information is tracked and reported monthly in the GSFC PMC as back-up charts. Each Project shall

demonstrate adequate levels of schedule reserve and cost contingency throughout formulation and implementation. Contingency should be calculated as a function of the estimated remaining schedule and cost to complete.

The reserve policy for STEREO is documented in the detailed cost breakdown presented at milestone reviews and reflected in annual POP submittals. STEREO's basic policy for cost reserve is to hold an overall reserve of 30% at the start of implementation. Schedule reserve is baselined as a minimum of one funded month per year of development. Cost breakdown and reserve phasing are outlined in Table 3.

**Table 3. Cost Breakdown and Reserve Phasing**

NOA Requirements

Launch 11/05 (from 12/05)	Prior Year	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	TOTAL
<b>Formulation</b>										
Proj Mgmt	5.8	2.2								7.9
Spacecraft	14.7	3.5								18.2
Instruments	16.8	8.6								25.4
SECCHI	11.5	5.0								16.5
SWAVES	1.0	0.2								1.2
IMPACT	2.7	2.5								5.2
PLASTIC	1.3	0.8								2.1
<b>Implementation</b>										
Proj Mgmt	-	0.4	3.2	3.7	3.5	1.0				11.7
Spacecraft	-	23.0	33.7	21.3	14.0	6.0				98.0
Instruments	-	10.0	19.0	16.6	10.9	3.4				59.9
SECCHI	-	6.5	11.6	10.8	8.0	2.0				38.8
SWAVES	-	1.0	2.3	1.3	0.7	0.2				5.6
IMPACT	-	1.8	3.4	2.9	1.7	0.7				10.5
PLASTIC	-	0.6	1.8	1.7	0.5	0.5				5.0
<b>Launch Vehicle</b>	0.2	0.3	9.7	27.5	26.8	4.2				68.7
<b>MO&amp;DA</b>						19.4	23.5	14.0	2.8	59.7
Mission Operations	-					11.0	9.8	4.5		25.3
Data Analysis	-					8.4	13.7	1.2		23.3
Extended DA	-						8.3	2.8		11.1
<b>Contingency</b>	-	5.0	8.7	21.0	6.0	5.3				46.0
Instrument Reserves	-	2.0	4.3	6.4	2.7	1.2				16.6
Spacecraft Reserves	-	3.0	4.4	8.4	2.5	2.4				20.7
Project Reserves	-	-	-	6.2	0.8	1.7				8.7
<b>GRAND TOTAL</b>	37.4	52.9	74.3	90.0	61.2	39.4	23.5	14.0	2.8	395.5
<b>POP 01-1 G/L</b>	37.4	52.9	74.3	90.0	61.2	39.4	23.5	14.0	2.8	395.5
<b>DELTA</b>	-	-	-	-	-	-	-	-	-	-
Average										
Instrument Reserves		20.1%	22.6%	38.6%	24.8%	34.9%				
Spacecraft Reserves		13.0%	13.1%	39.4%	17.9%	40.1%				
TOTAL Reserves		15.0%	15.6%	50.4%	21.1%	51.3%	30.7%			

A Termination Review may be called at any time during the implementation of a project if the estimated cost growth or schedule slippage exceeds the limits established in the PCA. Similarly, a Termination Review may be called if the estimated technical performance is reduced beyond the limits defined in the PCA. Should either of these two events occur, the GSFC Director of Flight Programs and Projects would consult with the Headquarters Sun-Earth Connection Theme Director as to the need for a Termination Review. Cost or schedule increases that are completely beyond the control of the Project Manager and project may be an exception to the need for a Termination Review. These increases could result in an increase to the cost cap or change in the schedule milestones subject to the recommendation

of the SEC Science Director and approval of the SSE AA. Approved changes will be reflected in modifications to the PCA and the STP Program Plan as appropriate.

There is no Allowance and Programmatic Adjustment (APA) held for the STEREO Project by the Office of Space Science or the Program Office. All reserves are controlled at the Project level.

The STEREO Project is verified for compliance with STEREO Project requirements by independent review during the AO selection, Phase A/B Review, and Mission Design Review. The Office of Space Science conducts the AO selection. GSFC Code 300 chairs the Phase A/B review with an independent assessment performed by IPAO. The Office of Space Science conducts the Confirmation Review.

## **10. IMPLEMENTATION APPROACH**

The Mission Integrator and prime contractor for the STEREO mission is The JHU/APL. Mission integration encompasses overall spacecraft development, design, and engineering, spacecraft subsystems and mission-unique equipment design, development and test, observatory integration and test, system engineering, observatory level performance assurance, launch operations, launch vehicle interface development. The term “observatory” is used to designate the spacecraft bus and its instrument complement.

### **10.1 Spacecraft Bus Development**

The two spacecraft will be as identical as possible. This provides for fabrication cost savings, testing simplification, and reduces the chance of assembly error. Deviations will be evaluated on a case-by-case basis. To date, the differences between the observatories are that the adapters on the bottom of each spacecraft differ and the upper observatory does not carry the separation ring for mass savings.

Basic instrument accommodations design drivers for the bus are electromagnetic interference (SWAVES receivers), magnetics (IMPACT magnetometer), electrostatic control (IMPACT/SWEA), contamination, and data rate (SECCHI).

The spacecraft bus is broken into eight subsystems: Command and Data Handling, Software, Guidance and Control, Power, telecommunications, mechanical, thermal and propulsion.

#### **10.1.1 Guidance and Control (G&C)**

The spacecraft is a three axis stabilized platform that relies on a guide telescope, star tracker, digital solar aspect detectors and an inertial measurement unit for attitude determination. Attitude control is accomplished by use of three reaction wheel assemblies (with a fourth for redundancy) configured as a zero-momentum system.

### 10.1.2 Power

The power system consists of two solar panels, a single 21 AH Super NiCd battery, a power distribution unit (PDU) and power subsystem electronics (PSE). The spacecraft is designed to operate all instruments at a 100% duty cycle. The battery is only used during launch, early orbit and during periodic propulsion events. The power system is peak power tracking.

### 10.1.3 Communications

During normal operations, the telecommunications subsystem provides downlink to the existing DSN 34m Bean Wave Guide (BWG) antenna system, supplemented by the 34m High Efficiency Front-end (HEF) and 70m systems, when necessary. The system provides for simultaneous X-band uplink, X-band downlink and tracking. A gimbaled high gain dish is used for the high rate data downlink (357 kbits/sec). Low Gain Antennae (LGA) for emergency communications and some limited science downlink. During the 20 hours per day when data is not downlinked to DSN, low rate space weather data will be broadcast at 557 bits/sec.

### 10.1.4 Command and Data Handling (C&DH)

The C&DH subsystem is responsible for uplink command and stored command management, telemetry data processing, mass storage of science and engineering data, execution of autonomous fault protection, maintenance and distribution of Universal Time, and subsystem intercommunication. The heart of the C&DH is the Integrated Electronic Module, first used on TIMED and currently being evolved from Contour and Messenger designs.

#### 10.1.4.1 Propulsion

The propulsion system provides 3 axis torques to stabilize the spacecraft after separation, 200 m/sec  $\Delta V$  for multiple earth flyby and final lunar flyby phasing maneuvers, mission orbit, and 3 axis torques for momentum wheel desaturation periodically throughout the two-year mission. A hydrazine propulsion system with three sets of four double canted 22N thrusters has been selected. System sizing includes volume margin as well as the capability to load 5 years worth of momentum dumping propellant.

#### 10.1.4.2 Software

The flight software management will be outlined in the Mission Software Development and Management Plan which will cover all software developed specifically for the STEREO mission. Each organization that develops software will use its own development process, which will be reviewed and documented in the Plan. During development, a peer review process at the program level will monitor software development at each institution according to its documented process. The West Virginia Independent Verifications and Validation facility will perform an independent assessment and review of spacecraft flight software.

#### 10.1.4.3 Thermal

The thermal design is simple and robust, utilizing only multiplayer installation blankets, heaters and radiators. The design, wherever practical, will envelope the orbits of both observatories. Instruments, in general, are thermally isolated.

#### 10.1.4.4 Mechanical

The spacecraft structural elements serve as the backbone for transferring all spacecraft loads. There is no separate device, such as a dual payload attach fitting for support of the spacecraft inside the fairing. The structure utilizes standard aluminum and honeycomb materials.

### 10.2 Launch Vehicle

STEREO observatories are to be launched together on the same DELTA 2925-10L. JHU/APL provides it's own support for the two observatories inside the fairing.

### 10.3 Ground System Development

The JHU/APL is responsible for ground system development for the mission operations center and observatory level integration and test ground system. GSFC Project Scientist is responsible. This task ensures that the design, procurement, integration, maintenance, and operation of ground systems enable the observatory to meet program level requirements.

### 10.4 Instrument Development

Each Principle Investigator is responsible for the design, development, procurement, integration and test, operations and maintenance of their respective instrument or instrument suite. STEREO Instrument Managers establish the performance, schedule, and cost baseline. The STEREO PS reviews the implementation and progress of individual investigations to ensure that the instrument performance is consistent with science requirements.

Detailed design is described in Preliminary Design Review packages (460-RVW-0045, 0046, 0047, and 0048).

### 10.5 Integration and Test

Prior to delivery to either Observatory for final integration, all subsystems and instruments must meet the applicable pre-integration flight acceptance requirements stipulated in performance specifications, design specifications, EMC specs, environmental specifications, subsystem test plans and/or general and specific instrument interface specs.

The object of observatory integration will be to verify all electrical and mechanical interfaces and to check functions and to a lesser extend, performance. The integration checks will be a

prelude to a more rigorous subsequent Observatory Acceptance Test, where performance is more meticulously checked.

Each observatory will be integrated independently, since few, if any, pairs of subsystems or instruments will be delivered together. I&T procedures will be the same for both observatories. Once observatories are full configured, testing may occur simultaneously when the situation permits.

Before hardware is turned over for integration, an Integration Readiness Review or that subsystem/instrument will be convened. The object of this review will be to familiarize the observatory system engineer, mechanical engineer, I&T engineering and others with the hardware, operational constraints, measured performance and special handling requirements.

A formal test and analysis program will be conducted to provide assurance that the hardware is capable of surviving and performing its mission within specification under the various environments to which it will be subjected. This program will demonstrate the validity of design, positive margins, quality of workmanship and materials, and satisfactory performance under the various mission environments with appropriate factors of safety. It will also screen the hardware for latent malfunctions. The program will include functional tests at the box and system levels. These tests will be conducted under ambient and simulated mission conditions, including factors of safety as applicable. Verification activities will demonstrate compliance with the system safety requirements as appropriate.

End-to-end testing will be conducted to ensure command and telemetry capability with the control center. Recorded and real-time satellite data will be relayed through the operational ground system to verify data compatibility with the ground system and data processing facility. Mission simulation exercises are conducted to validate nominal and contingency mission-operating procedures and provide for operator familiarization training.

Integration facilities at the JHU/APL will be utilized for observatory I&T with the exception of the EMI and thermal vacuum, which will occur at the GSFC.

## 10.6 Mission Operations

The STEREO spacecraft will be operated by the JHU/APL utilizing the DSN for communications with the spacecraft after launch. The bus and instrument suite will be operated in a decoupled fashion. The Mission Operations Center (MOC) will support all spacecraft bus operations. Instrumenters will be responsible for support for their instruments, providing command loads to the MOC and receiving data via the MOC. All spacecraft servicing, including commanding and data recovery will occur during a single ground contact each day. Spacecraft command messages will be uploaded and real-time engineering data will be downloaded and evaluated to assess spacecraft health. Solid-state recorder data will be played back on each contact and all science data will flow to the instrumenters in near real-time.

## 10.7 Data Management

The STEREO investigation team will be responsible for initial analysis of the data, their subsequent delivery to an appropriate data repository, the publication of scientific findings, and communication of the results to the public.

In accordance with NASA policy, data are to be released as soon as possible after a brief validation period appropriate for the mission. There is no proprietary period for the Principle Investigator's (PI) science team for exclusive use of the data for scientific analysis. The STEREO PI and Mission Scientist shall prepare a Science Data Management Plan for approval by the Project.

The STEREO PI team will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the scientific data prior to delivery to the appropriate science data archive center for dissemination. The interface requirements, data formats, and other standards for delivery of data products will be worked with the appropriate science data archive center and reflected in the projected plan.

The SECCHI, SWAVES, IMPACT, and Plastic Principal Investigators shall be responsible for initial analysis of the data, its subsequent delivery to an appropriate data repository, the publication of scientific findings, and communication of results to the public.

Additionally, the PI's shall be responsible for collecting engineering, and ancillary information necessary to validate and calibrate the scientific data prior to depositing it in a NASA approved data repository.

## 10.8 Logistics

The JHU/APL provides for planning and provisioning of logistics for the spacecraft and observatory. Principle Investigators are responsible for instrument level logistics.

## 11. **ACQUISITION STRATEGY**

The STEREO scientific investigations are procured through the AO process. The PI may be from any category of US or non-US organizations, including educational institutions, industry or nonprofit institutions, or from one of the NASA Centers, the Jet Propulsion Laboratory (JPL), other Federally-funded research and development centers, or other US Government agencies. The PI teams may be formed from any combination of these institutions. The AO selection of a PI teams provides the full authority necessary to contract with all members of that team without further competition.

The STEREO spacecraft, ground support, mission operations, and mission integration function is a sole source procurement to JHU/APL.

KSC launch services contract is utilized for acquisition of the launch vehicle.

The GSFC STEREO Project Office is delegated NASA's fiduciary responsibility to ensure that the STEREO mission is achieved in compliance with committed cost, schedule, performance, reliability, and safety requirements. Support to the project office is available via one or more task contractors.

A summary of procurement items is shown in Table 4.

**Table 4. Summary of Procurement Items**

Procurement Items	Procurement Type	Contract Type	Source	Procuring Activity	Technical Monitoring
SECCHI instrument suite	AO	NASA/Defense Purchase Request	Naval Research Laboratory	GSFC	GSFC
IMPACT instrument suite	AO	Cost reimbursable	UC Berkeley	GSFC	GSFC
PLASTIC instrument	AO	Cost reimbursable	Univ. New Hampshire	GSFC	GSFC
SWAVES instrument	AO	International LOA	Observatoire de Paris-Meudon	Code I	GSFC
Spacecraft/mission integration/mission ops	Sole source	CPFF	JHU/APL	GSFC	GSFC
Launch Services	N/A	N/A	KSC	KSC	KSC
Project Technical Support	Competitive	CPAF	Various	GSFC	GSFC

## **12. PROGRAM/PROJECT DEPENDENCIES AND AGREEMENTS**

### **12.1 Dependencies**

Launch services for STEREO will be provided by the Kennedy Space Center. KSC will manage procurement of the vehicle and launch services and will supply launch vehicle resource requirements via the program operating plan.

### **12.2 International Agreements**

The STEREO Project shall be conducted in consideration of Letters of Agreement (LOAs). Management of International Traffic and Arms Regulations (ITAR) requirements is outlined in the STEREO Export/Import Plan (460-PLAN-0025). The following agreements are in place for the STEREO mission:

#### 12.2.1 Letter of Agreement with France

LOA with CNES regarding provision of their contributions to the SWAVES, SECCHI, and IMPACT instrument suites (460-AGMT-0008).

#### 12.2.2 Letter of Agreement with Hungary

LOA with Hungary regarding provision of their contribution to the IMPACT investigation (460-AGMT-0005).

#### 12.2.3 Letter of Agreement with Switzerland

LOA with Switzerland regarding provision of their contribution to the PLASTIC instrument suite (460-AGMT-0006).

#### 12.2.4 Letter of Agreement with United Kingdom

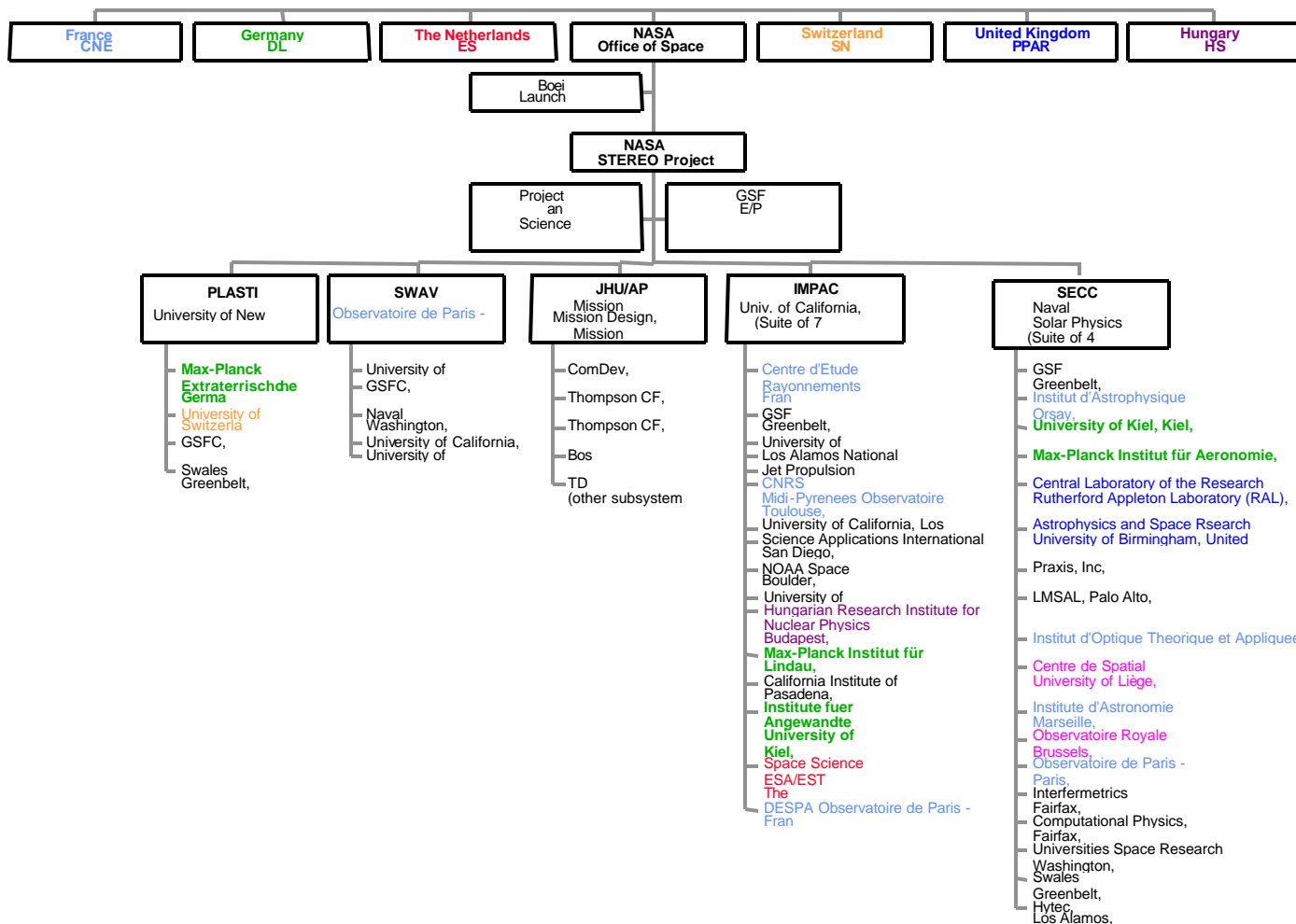
LOA with the Particle Physics and Astronomy Research Council (PPARC) regarding provision of their contribution to the SECCHI instrument suite (460-AGMT-0009).

#### 12.2.5 Letter of Agreement with Germany

LOA with DLR regarding provision of their contribution to the SECCHI, IMPACT, and PLASTIC instrument suites (460-AGMT-0010).

#### 12.2.6 Letter of Agreement with European Space Agency

LOA and MOU with ESA regarding provision of their contribution to the IMPACT instrument suite (460-AGMT-0007).



**Figure 3. International Organizational Chart**

### 12.3 Service Level Agreements

A Project Service Level Agreement (PSLA) with Space Operations Management Office (SOMO) has been developed for coordination of operational support required for STEREO. The acquisition of Deep Space Network time is the primary purpose of this agreement. The PSLA will be reviewed annually and updated as required.

## 13. MISSION ASSURANCE

The STEREO mission assurance requirements are documented in the STEREO Spacecraft Mission Assurance Requirements and Instrument Mission Assurance Requirements documents (460-RQMT-0005 and 0022).

## **14. RISK MANAGEMENT**

The STEREO Project will continually manage risk relative to mission safety, mission success, and cost. This process is documented in STEREO Risk Management Plan (460-PLAN-0007).

The STEREO Project will manage risk primarily through an approach of continuous surveillance. Regular weekly team meetings and senior Project staff meetings will be used to quickly identify and assess mission risks. Relaxation of non-critical technical requirements and schedule compression are the principal tools available to the STEREO mission for risk mitigation or balancing. The Project was initiated with the acknowledgement of NASA's Office of Earth Science that this was a moderate-risk development effort and that the flight segment implementation would be selectively redundant. Performance goals are alterable only as approved by the Office of Space Science.

## **15. ENVIRONMENTAL IMPACT**

The STEREO Project shall conform to NASA and US environmental requirements for mishaps, orbital debris, radiation sources, and other environmental concerns. The request for Environmental Impact Analysis (AF FORM 813) has been approved by the Air Force. It will be reevaluated annually. Environmental assessments will be accomplished via the Environmental Assessment of NASA Routine Payloads program. Inputs to the Routine Assessment will be updated as required.

## **16. SAFETY**

Stereo requirements for industrial, range, and system safety are outlined in the Mission Assurance Requirements Documents (460-RQMT-0005 and 022). The implementation approach to these requirements will be outlined in the mission safety implementation plan.

## **17. TECHNOLOGY ASSESSMENT**

Two instrument technologies are being developed for STEREO. The COR1 coronagraph of the SECCHI instrument suite has been developed for ground use and is now being advanced to flight levels. The Heliospheric Imager, also of SECCHI, is a new instrument.

## **18. COMMERCIALIZATION**

STEREO investigators are encouraged to commercialize any new technology items associated with this mission. However, as a strategic mission, technology readiness levels are generally high and commercialization opportunities relatively rare.

## **19. REVIEWS**

STEREO implements comprehensive review program involving a series of independently run milestone reviews as well as project sponsored peer reviews. The GSFC Systems Review

Office (SRO) will manage and chair all major technical reviews. The Chief Systems Engineer (CSE) chairs all Peer Reviews and maintains the Peer Review schedule. Independently of the project, an Independent Review Team designated by the Office of Space Science will perform programmatic and technical assessments of the projects via annual program level reviews. The Office of Space Science, in conjunction with Code AE, is responsible for preparation and approval of the Independent Review Plan.

The STEREO project level review program, with timing, content and purpose of all reviews is described in detail in the STEREO Review Plan, 460-AGMT-0016.

Approved project reviews are listed below:

### **Mission Level Reviews**

- System Requirements Review (SRR)
- Ground Systems Requirement Review (GSRR)
- Independent Assessment (IA)
- Pre-Confirmation Review
- Preliminary Design Review (PDR)
- Mission Confirmation Review (MCR)
- Critical Design Review (CDR)
- Pre-Environmental Review (PER)
- Pre-Ship Review (PSR)
- Mission Readiness Review (MRR)
- Flight Readiness Review (FRR)
- Launch Readiness Review (LRR)

### **Payload Reviews**

- SECCHI, PLASTIC, SWAVES, IMPACT PDR
- SECCHI, PLASTIC, SWAVES, IMPACT CDR
- SECCHI, PLASTIC, SWAVES, IMPACT PER
- SECCHI, PLASTIC, SWAVES, IMPACT PSR

### **Operations Reviews**

- Mission Operations Review (MOR)
- Flight Operations Review (FOR)

### **PEER Reviews**

#### **Spacecraft**

- Mission Design
- Systems Engineering
- Mechanical & Structures
- Propulsion
- Thermal
- Power

Integrated Electronics Module (C&DH)  
 Guidance & Control  
 RF Communications  
 Flight Software  
 Ground Systems (H/W & S/W)  
 Integration Assembly and Test  
 Product Assurance

### **Payload**

SECCHI  
 COR1  
 EUVI/GS/Mechanisms  
 SCIP & COR2  
 SEB, SW, Ops, Data System  
 HI  
 CEB, FPA  
 PLASTIC  
     Overall & Ground SW, Ops, Data System  
 IMPACT  
     Boom, STE, SWEA  
     MAG, SEP (SIT, SEPT, LET, HET)  
     IDPU, SW, Ops, Data System  
     Systems Overview  
 SWAVES  
     Antenna, Mechanical  
     Receivers  
     Elect, DPU, SW

### **Integrated Peer Reviews**

Contamination and Control  
 Instrument EMI/EMC/Magnetics

## **20. TAILORING**

The STP Program Commitment Agreement allows that “methods that provide the equivalent content to Earned Value Management are used to assess technical, cost, and schedule parameters during mission and Program execution.”

Formal Earned Value Management (EVM) is not being adopted for the STEREO Project since the primary contracts are with educational institutions that do not have the accounting systems to properly support EVM. It would not be cost effective to require EVM compliance by those institutions. Status reporting of cost and schedule milestones will allow for a system of tracking equivalent to a formal EVM program. Similar methodologies were utilized successfully for ACE and FUSE projects.

The project distributes information from science, engineering, and technical management as openly and as rapidly as allowed by Export Administration Regulations and International Traffic in Arms Regulations.

It makes a commitment to continuous learning and competence in mission and program management by permitting substitutions of required courses for experience and by holding program and mission managers' line supervisors accountable for annual training requirements.

By agreement with the Program Executive and STP Program Manager, the technical performance commitments are an accepted exception to the PCA. This exception will be reflected in the future update of the STP PCA. The exception to the technical performance metrics is:

The PCA states, "A minimum of 75 percent of the scientific instruments on each mission will operate successfully for one year after launch." The STEREO Project will not implement this metric in any of the mission requirements.

Schedule and Cost commitments of the PCA were set for STEREO prior to launch changes for Solar B and TIMED missions as well as implementation of NASA Independent Assessment Team (NIAT) requirements. As only TIMED was in implementation at the time, it is accepted that milestones and cost profiles will be updated in future PCAs.

## ACRONYM LIST

<b>AA</b>	Associate Administrator
<b>ACE</b>	Advanced Composition Explorer
<b>AO</b>	Announcement of Opportunity
<b>APA</b>	Allowance for Programmatic Adjustment
<b>BM</b>	Business Manager
<b>CR</b>	Concept Review
<b>CSE</b>	Chief Systems Engineer
<b>DPM</b>	Deputy Project Manager
<b>EOS</b>	Earth Observing Satellite
<b>EPA</b>	Environmental Protection Agency
<b>EVM</b>	Earned Value Management
<b>FRR</b>	Flight Readiness Review
<b>GSFC</b>	Goddard Space Flight Center
<b>IM</b>	Instrument Manager
<b>IRIS</b>	Italian Research Interim Stage
<b>JHU/APL</b>	Johns Hopkins University/Applied Physics Laboratory
<b>LRR</b>	Launch Readiness Review
<b>MOC</b>	Mission Operations Center
<b>MOR</b>	Mission Operations Review
<b>MRR</b>	Mission Readiness Review
<b>NCR</b>	Non-Conformance Report
<b>NRAs</b>	NASA Research Announcements
<b>ORR</b>	Operational Readiness Review
<b>OSS</b>	Office of Space Science
<b>PD</b>	Position Description
<b>PER</b>	Pre-Environmental Review
<b>PI</b>	Principle Investigator
<b>PM</b>	Project Manager
<b>POP</b>	Program Operating Plan
<b>PSR</b>	Pre-Ship Review
<b>SE</b>	System Engineer
<b>SRO</b>	Systems Review Office

## REFERENCES

PCA	460-AGMT-0003
SRR	460-RVW-0001
Program Plan	460-PLAN-0005
Risk Management Plan	460-PLAN-0007
S/w Mgmt Plan (draft)	460-PLAN 0021
PLSA	
CC Plan (draft)	460-PLAN-0024
Export/Import Plan	460-PLAN-0025
STP/APL Partnership	460-RVW-0029
Phase A STEREO	460-RPT-0031
PDR SWAVES	460-RVW-0045
PDR IMPACT	460-RVW-0046
PDR PLASTIC	460-RVW-0047
PDR SECCHI	460-RVW-0048
Pre-Confirmation Review	460-RVW-0052